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ABSTRACT

Although the Ceylonese Education Department based its revision of school science curricula on a 1963 UNESCO report, little use has been made of members of the universities. This has resulted in courses containing much confusion and absurdity, at least in biology. An alternative biology project was established by the Ceylon Association for the Advancement of Science, utilizing co-operative teams of school and university teachers, but it also has some drawbacks. The new courses, however, have not been adequately assessed in the public examinations which also serve as entrance examinations to the universities. The Education Department has imposed unsuitable assessment techniques which the universities are expected to help implement, even though they were not consulted during the development of procedures. There is evidence that there is official discrimination, based on racial origin, in selection for university admission. Too many university staff are not using adequate scientific criteria in their experimental design and publication activities; this will have deplorable consequences on education and on the provision of adequate scientific bases for the development of Ceylonese applied science. (Author/AL)

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LECTURE TO SECTION D

Presidential Address

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by

H. CRUSZ

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SECTION D—NATURAL SCIENCES

Presidential Address*

SOME TRENDS IN SCIENCE EDUCATION AND SCIENTIFIC RESEARCH IN CEYLON

by

H. CRUSZ

University of Ceylon, Peradeniya

I am deeply grateful for the honour you have done me in having elected me President of the Natural Sciences Section of the CAAS.

I was in two minds when it came to selecting a theme for my Presidential Address. I was greatly inclined to reviewing a field of knowledge related to my own researches, but I have deferred to a large number of my colleagues who were of the opinion that our times call for some plain speaking on matters relating to science education and research in Ceylon.

I am comforted by the thought that Presidential Addresses of most Associations for the Advancement of Science have, instead of " reviewing fields of knowledge", started " raising wider questions of science in the country concerned, namely policy, utilisation of results of research, organisational problems and ethical questions in the context of science and society "(1).

In adopting a similar attitude, I am going to paint for you today a rather plain and straightforward picture on the subject of my address. In doing so I shall try my best to avoid the elongations of an El Greco or the deliberate distortions of a Picasso, or even the intellectualism of so-called Abstract Art. I shall " concretize " as far as possible. Once in a way, I shall even do what some abhor, namely " anecdotize ". One need not be apologetic about this, however, for according to the Oxford Dictionary anecdota simply mean " unpublished details of history ".

*delivered on 17th December, 1970

I shall therefore begin with such an anecdote. The British *Times Educational Supplement* of December 5, 1969, carried an advertisement from the Ministry of Overseas Development and the British Council, which read as follows :—

> " Tutors are required to help staff in-service teacher training courses for local teachers which are to be held in various centres in Africa, Asia, the Caribbean and the Mediterranean in summer 1970.....
>
> CEYLON (i) Tutors for a course in science (Chemistry, Physics and Biology) at " Advanced Level ".....
> 4 weeks duration.....
>
> Candidates must be Heads or Deputy Heads of Primary or Secondary Schools, Heads of Departments of Secondary Schools or Lecturers in Colleges of Education, Establishments of Further Education or University Schools of Education in the U.K."

This advertisement so intrigued a Ceylonese in the U.K. that he wrote to a high academic in Ceylon, expressing his surprise and concern and requesting some clarification as to what the project really meant. The implications were however quite clear. Ceylon has to depend on tutors from abroad for teaching her ' A-Level ' teachers how to teach, even with regard to subjects like biology, where one would expect not only a teacher, but more so a teacher of a teacher, to have first-hand acquaintance with local organisms and local environmental conditions and problems. In saying this I mean no disrespect whatsoever to those kind and brave people from Britain who have come to Ceylon in response to this call. I only ask them and you to join me in further considering this matter.

In view of this rather uncomplimentary state of affairs, we should examine the steps that have been taken so far to develop and improve science-education in Ceylon, and see whether we have been on the right track and what, if any, are the impediments to further progress in this direction.

Government's Science Teaching Development Programme—'Ordinary Level'

I do not think one could doubt for a moment that the Government of Ceylon's Education Department has initiated and carried out programmes of science teaching development, which have had an impact even on educational circles in other countries. In keeping with the urge everywhere, not only in developing countries, but in the developed ones as well, to rethink curricula in relation to the demands of a modern scientific, technological and democratic age, Ceylon too began planning her Science Development Programme as far back as 1957, with UNESCO assistance. A survey revealed that there were 3 levels of science teaching that needed attention, namely Grade 6-8 Level (11 + to 14 + age-group), Grade 9 & 10 Level or G.C.E. ' O-Level ' (14 + to 16 + age-group) and Grade 11 & 12 Level or G.C.E. ' A-Level ' (16 + to 19 + age-group) (2).

The thinking and the educational experimentation that went into the initial stages of this Programme, in relation to the first two Levels, have been recorded in the 1963 Report prepared for UNESCO by the Department of Education, Ceylon. Special mention must be made of over 19 Working Principles and Criteria which emerged from these studies and which were to be guide-lines for future work on Syllabuses of Instruction and Schemes of Work in science teaching at these levels. For example, it was decided that the schemes should contain " many common points of contact with the current schemes elsewhere in the world ", due regard being paid to the Ceylon situation. By this was meant the new orientations such as reduction of informational content not directly essential to the establishment of important concepts and models, the increase of student involvement in scientific activity including open-ended experiments, the increase of skills in the quantitative aspects of investigation, and provision for periodic evaluation of the schemes. It was also cautioned that the new schemes of work should not demand a complete re-training of existing staff, although some re-orientation in methods and attitudes of teachers had to be achieved if there was going to be any change from the *status quo* in science teaching. In the specific Ceylon setting, it was also recommended that " teaching methods should involve the barest minimum of killing of animals and collection of killed material ".

Perhaps one of the most important guide-lines was that the design of the schemes should be double-based, namely 1) on the logical development of the subject and 2) on the significance of the material from the point of view of its applicability and usefulness in everyday life.

Armed with such a valuable set of findings, the Department set about producing materials for school use in the 'O-Level' Classes in Physics, Chemistry and Biology. This was done by the Department's own staff and the materials have been in use in schools since 1964. Revision in selected areas has been done by the Department's Biology Curriculum Team. It is on record that " when a national or public curriculum is to be revised a special committee is appointed for this purpose. This committee will be composed of the official of the Ministry, the members of the universities and experienced teachers" (2).

In spite of this, very little use has been made of the " members of the universities ". There has been no determined effort to use them as fully as possible and with as wide a coverage as possible from the point of view of specialists in all aspects of the subject. Soliciting the help of a few university people, generally on a personal basis, is hardly a way of tackling so vast and exacting a problem.

There is also the very real hazard of not having the right type of university teacher and researcher among the few who are used, if they are used at all, for curriculum writing and revision. This assumes special importance when it is viewed together with the observations made later on in this address, in regard to trends in scientific research in this country.

All in all, there is nothing like having a formidable body of competent biologists, drawn equally from the universities and from the schools, to write and revise a biology curriculum. This has been the tested experience of the world's best curriculum revision projects in biology, such as the Biological Sciences Curriculum Study (BSCS) of the U.S.A. (*see* Grobman, 1969) (3) and the Nuffield Project of Great Britain.

I am not competent enough to deal with the teaching materials in Physics, Chemistry and Mathematics. Even if I were, it would not add much to my argument. For, if it can be shown that one

such scheme, for example the biology scheme, is deficient in several respects, then, even if the other schemes are admirable, there will already be an undesirable imbalance in science teaching at the ' O-Level '. One has to be careful about this in planning a course. Hulda Grobman's words (1966/69), written in another context, could be applied here too. " It may be ", she says, " that one cannot expect student performance to reflect the new thrust in a biology course until there are parallel new thrusts in other curricula consistently throughout the school and college years " (4).

I would classify the deficiencies in the Education Department Schemes in Biology as follows :—

1) Errors and howlers that pass off for facts.
2) Pedagogically unrealistic treatment of certain teaching sequences.
3) Spelling out of outcomes, which could easily degenerate into dictation.
4) General imbalance in choice or omission of subject matter.
5) Lack of Ceylon data, despite the considerable amount of applied biology in the course.
6) Lack of correlated sample test-papers and guidance for teachers in evaluation techniques.

The strong points in the schemes, on the other hand, stem from the original aims and guide-lines, however much the actual schemes fall short of them. The very fact that new schemes were started at all is praiseworthy. The deficiencies would however appear to stem from one serious situation in the whole programme, namely the lack of expertise and the right type of personnel for producing at least satisfactory materials, let alone materials of a high quality.

Facts are the foundation of scientific work. Even in open-ended experiments, i.e., experiments where the results are not anticipated at the beginning of the exercise, one has to set about one's task, equipped with preliminary facts and assumptions. Unfortunately, the teacher's guides produced in at least one subject, biology, have so many errors and howlers, that one loses confidence in the accuracy and the authenticity of the material. Even in science, statements have to have some degree of credibility.

This problem is so acute that it led one educationalist (Jayasuriya, 1969) to quote, from " a single term's course guide of 56 pages ", eight selected passages which he described as " confusions and absurdities which mystify the young science graduate " (5).

Here are a few more examples from the same work (6) (italics mine) :—

(*a*) " The occurrence of changes in the form and structure of animals in the development o*f an egg* to adult is known as metamorphosis ". (p.11).

(*b*) " Self-fertilisation is a sexual means of reproduction, but a regression from true sexual form, offering a lesser chance of variations or mixation but higher than in vegetative means ". (p.46).

(*c*) " In a large population there are as many individuals having one character as those having the opposite character ". (p. 48). In regard to this particular so-called " main teaching outcome ", W. H. Dowdeswell of Bath University and Nuffield Project made the following comment, with characteristic British understatement: " Meaning not clear ; surely this is not so ? " (7).

Here are some more from the Scheme for the First Year—Second & Third Terms (8) :—

(*a*) " Recall the enzyme ptylin. Similar enzymes are produced in the stomach and small *and large intestines* ". (p.36).

(*b*) " The importance of bacteria in the digestive systems of Termites can be mentioned. *No enzymes are effective in the digestion of cellulose.* Termites feed on cellulose. The cellulose is decomposed by the bacteria present in the digestive system. Hence the Termites would not be able to support themselves on cellulose but for the bacteria" (p. 53).

(*c*) " The incisors *as well as the molars* (of the rat) are continuously growing to replenish wastage in gnawing ". (p. 31).

It is relevant to refer to two answers that have been given to criticisms of these texts. First, that it is wrong to refer to the " English " version of the texts, when it is Swabasha that is being used in the schools. Secondly, that the texts are only " provisional " as has been clearly stated in the prefaces to the different schemes, where criticisms have been solicited.

The first is hardly an answer to our criticism. If at all, the chances are greater that Swabasha translations will be not any better, even worse, than the original " English " text, not necessarily from the point of view of language, but from the point of view of further distortion of factual material. With this would go the added disadvantage that the chances of rectifying errors and howlers will be much more remote, since Swabasha materials would be available to a far smaller population of competent judges. The errors could therefore thrive longer in such a situation.

That the texts are " provisional ", is no answer to a situation where immediate withdrawal or revision is called for by the very nature of the material purveyed. I shall refer to this again in the next section. Problems like this no doubt arose even in the BSCS programme, when, at one point, " the discussions were rather heated " and the Steering Committee members had to be reminded that they were " not criticising finished books " but " trying to improve embryo books " (Grobman, 1969) (3). I do not think that the local counterparts deserve to be called even " embryo books ".

CAAS School Biology Project—' Ordinary Level '

It must be said, to the credit of those Education Department officials who were most involved in policy making, that they themselves probably felt a certain uneasiness at their own biology materials. This might account for the readiness with which their support was given for the inauguration in 1964, and the continuance, of the CAAS School Biology Project (SBP) and also for the fact that all the " Syllabuses of Instruction and Schemes of Work in Biology for G.C.E. ' O-Level ' Classes " (6, 8) carried an announcement to the effect that the CAAS has commenced a School Biology Project, the aim of which was to " improve the teaching of Biology at the G.C.E. Ordinary Level in Ceylon Schools ". There was also

a somewhat puzzling statement to the effect that " the School Biology Project welcomes any criticisms of, and improvements to *this scheme* ", i.e. the Education Department's Scheme.

This raises an important issue. The criticisms to the Education Department Scheme were to be directed not to that Department, but to the SBP. That would have been understandable, if the SBP was going to supplant the Education Department's project. Actually, the SBP is a parallel project. One would have therefore expected the Education Department itself to have been the sole recipient of criticisms of its own schemes. In fact, in at least one text (9) it is stated that such criticisms had indeed been received during the preparation of these " provisional schemes", from members of the University of Ceylon, Training College Staffs and Inspectorate, but that "the nature of the task prevented the incorporation of many of the useful suggestions that were made." However, a further notice added " that the co-operation of teachers in teaching these syllabuses and their assistance in such revision is earnestly solicited."

I shall not go into the details of the formation and work of the SBP. Most of you are familiar with them, as the Project is a CAAS undertaking, and they are in any case on published record (CAAS Annual Reports since 1964, and Crusz, 1966/69 (10) and Basnayake, 1969 (11)). It is enough merely to say that the thinking and work of the SBP have been enthusiastically appraised in educational circles both here and abroad. Grobman (1969) in his significant book *The Changing Classroom* writes of the " numerous materials " of the SBP " which are quite original in concept and take advantage of already published items, including those produced by the BSCS, the Philippine adaptation of the BSCS Green Version and the Nuffield Foundation of Great Britain. One of the features of the Ceylonese work is a series of problems similar to *Invitations to Inquiry* based solely on biological data from Ceylon. The next step in the work of the Ceylonese project is to translate some of the experimental materials into Sinhalese and Tamil for trial use with students under local conditions" (3).

In fact, this last step has already been taken, with some 23 classes in 16 schools in the Kandy district, and valuable feed-back has been obtained. The first examination based on the SBP coarse was held in December 1969. SBP questions formed part of the

G.C.E. (O-Level) paper for SBP candidates sitting the Government Examination. These questions were set by SBP personnel and it was a most progressive step in that accommodation was made in a public examination for candidates taught in a non-governmental curriculum trial.

In all its work of programming, writing, teaching, examining and evaluating, the SBP has relied on the co-operation of several teams comprising school and university biologists in almost equal numbers. In fact in 1968 the National Council for Higher Education, on a request made by the CAAS, recommended to all the universities that "(a) members of the academic staff of the universities be given official permission to continue to assist in the work of the School Biology Project, and (b) Some recognition be given to those who spend time and effort on such work".

In spite of this, there are several shortcomings even in the SBP schemes. Some of these drawbacks are shared with the Departmental schemes. Let us have a look at those that have been so far recognized.

1) The SBP has also emphasized the main ideas, but these have to be elicited in the course of the encounter in class between teacher and pupils. The outcomes are not spelled out as in the Departmental Schemes, so that dictation of material is not possible in the SBP course.

2) Like the Departmental course, the SBP course could lead to a strait-jacketing of teaching. There should be more scope for alternative approaches, on the teachers' own initiative.

3) Neither course has dealt adequately with project work. It is hoped that ways and means of doing this will emerge from the Third Biennial Conference of the Asian Association for Biology Education (AABE), which is scheduled to begin in Manila on December 28, 1970. The theme of that Conference will be "Research Projects in School Biology Teaching", a theme suggested by Ceylon's SBP. Some of the project papers to be presented by Ceylonese school-teachers at this Conference are interesting: (1)

"'Green' Bean and 'Butter' Bean—Varieties or Species" by Miss P. Marandawela of Menikdiwela Maha Vidyalaya; (ii) "Supporting Function of Collenchyma as seen in the Petiole of *Typhonium roxburghii*" by Mrs. I. Eriyagama of Girls' High School, Kandy ; (iii) "Colour Changes in the Petals of *Hibiscus mutabilis*" by Mrs. G. J. Hoole of Hillwood College, Kandy; (iv) "Age of Menarche in School-girls in Kandy, Ceylon" by Miss P. Dissanayake of Maha Maya Girls' School, Kandy; (v) "Some Observations on the Breeding Habits of the Ceylon House Sparrow" by Mr. C. J. S. Daniel of Trinity College, Kandy and (vi) "The Amount of Water Given out from Leaves of Different Ages" by Mr. A. Weerasinghe of Trinity College, Kandy.

4) Mathematics has played too small a part in both courses. This is a serious drawback, if Mathematics is at the very base of scientific investigation.

5) Neither course has placed enough emphasis on field work and ecology and in the acquisition of a cultivated awareness of one's environment for its own sake. The teaching of nature conservation might become difficult in such a situation, without the necessary emotional build-up which science teaching can achieve. In this connection it should also be noted that in both courses non-verbal learning has been almost totally neglected. Aldous Huxley's *Island* (1962) which provided a take-off point for a previous essay on Science Education (Basnayake & Crusz, 1966/69) (12) speaks of one of the prescriptions for sound education in the utopian island of Pala, namely "Discouraging children from taking words too seriously .....But what you can get out of a book is never *it*. At bottom, all of you are still Platonists. You worship the word and abhor matter." (13).

6) Lastly, what has been done to foster creativity ? We are preoccupied with, and catering for, the average pupil. This can be dangerous. The problem was recognised by both the great curriculum projects, BSCS and Nuffield, and they have tried to solve it in their own different ways.

' Advanced Level ' Teaching and Examinations

I have been so far trying only to prepare the way and lead you up to what I would like to call, without any exaggeration, the debacle of the G.C.E. (A-Level) teaching and examinations. You would remember that I started with an anecdote concerning teachers from the U.K. for training ' Advanced-Level ' science teachers in Ceylon. We shall return to that theme once again.

For many years the General Certificate of Education (Advanced Level) Examination, the Higher School Certificate Examination and the University of Ceylon's Preliminary Examination were different things. From 1952 to 1963-68 Ceylonese candidates sat the G.C.E. (A.L.) Examination conducted by the University of London. The Practical Tests for this Examination were set by examiners in London and conducted and sometimes even marked, on instructions from London, by local examiners from the University of Ceylon.

The University of Ceylon's Preliminary Examination was held right up to 1963. The H.S.C. Certificate was given by the Education Department on the performance of candidates at the University Preliminary Examination.

With the decision to do away with the London Examinations and hold a local G.C.E. (A.L.) Examination, the Commissioner of Examinations took the responsibility for conducting the A.L. Examination and the Controlling Chief Examiners were Heads of Departments of the University, while a good proportion of the Assistant Examiners, at least in the science subjects, were also drawn from the University. The University's Faculty of Science and Senate insisted on University involvement at least to this extent, as long as the A-Level Examination was going to function as a University Entrance Examination as well.

The Preliminary/H.S.C. Examination was held for the last time in 1963 and the Ceylon A.L. Examination came to function in and after 1964 not only for purposes of a General Certificate of Education but also as the University Entrance Examination. Indeed, the University Preliminary Examination syllabuses, at least in the science subjects, continued to be used for the new A.L.

Examination and even the number of papers to be taken at the Examination remained the same. From 1965, two papers were set in each subject, but still on the rather limited Preliminary Examination syllabuses. In 1967, the syllabuses were also changed to make them conform to A.L. standards in the U.K.

The use of the A.L. Examination as a University Entrance Examination resulted in several misconceptions in the minds of everybody regarding the true nature of an A.L. Examination as against a selective examination for University purposes. The Ceylon A.L. Examination was almost foisted on the country with no adequate planning and preparation. Sound and concrete recommendations made by the Controlling Chief Examiners for setting up a qualified and representative board to deal with the conduct of the Examination in a uniform and satisfactory manner were largely ignored, and the authorities went on regardless for the last seven years.

The University personnel tried to do their best in the circumstances. A very early inclination, on the part of some at least of the Science Examiners, not to have anything to do with the conduct of the Examination, faded away owing to considerations of the importance of University involvement, whatever the circumstances, as long as the Examination was being used for University Entrance purposes as well. In the G.C.E. (A.L.) work, as in the G.C.E. (O.L.), there was a definite tendency for certain sections of the education authorities to try to go it alone without University help and involvement. The only way the universities were involved was when the heads and other senior teachers in the University science departments were invited to occasional "Conferences" generally to get University help in implementing decisions already taken by the Government officials. The dons mostly revolted at such an attitude. One could have condoned this attitude on the part of the authorities, if there were able and adequate personnel among them to do the job. But it was obvious that that was not the case.

The gulf between the University of Ceylon and the other newly established universities on the one hand, and the Government Education authorities on the other, was widening more and more. This is now part of the political and educational history of our

country. Ministers of Education came and went, but the men who really wanted power at the expense of educational standards and the intellectual future of our children remained. The technique adopted was to mess up as completely as possible and then blame it all on the universities.

The science departments of the University of Ceylon and the CAAS School Biology Project, which was closely linked with them, began thinking seriously about the A.L. situation. This led in February 1967 to the Director of the SBP sending a memorandum on the subject to the education authorities. It was " An outline of a proposal for curriculum revision in biology at G.C.E. (A.L.) and General Science Qualifying Level (first year in University biology)". In the course of this memorandum the SBP Director states " It seems a pity that no studies are being done of this curious transitional phase in the history of science education in Ceylon. More concrete evidence that A.L. biology curricula will inevitably undergo revision includes the fact that the Departments of Botany and of Zoology in the University of Ceylon, Peradeniya, have already prepared tentative drafts of new A.L. syllabuses in Botany and Zoology (Appendix). There have been meetings of University A.L. Examiners to consider overhauling the A.L. Examination. These are signs of a movement towards A.L. curriculum revision, and while the causes of such a movement are likely to be multiple and complex rather than single and simple, it is interesting to note that the movement is most marked in biology rather than in chemistry and in physics " (14). The SBP Director goes on to discuss the impact of curriculum revisions in A.L. and University biology in other countries and he reads signs of dissatisfaction with the Ceylon A.L. and G.S.Q. Examinations even among University Examiners themselves. He rounds off the memorandum with a plan for curriculum development, including its financial implications. It was hoped that the fiscal support would come from the Asia Foundation or other donors, through the Ministry of Education. The memorandum was fully discussed and well received at a SBP meeting at which there was a very representative body of biologists from the University of Ceylon. Even a prototype question paper was prepared.

The Education Ministry did not appear to be interested, and so nothing came of all this. The prototype question paper itself is still in cold storage. Very soon however we heard of the Education Ministry's utilising U.K. aid for proceeding with their in-service institutes for A.L. teachers during the holidays. This entailed regular visits of foreign personnel for the purpose of teaching our school science teachers the art of teaching subjects like Physics, Chemistry and even Biology at A-Level. Very curiously our own University personnel were consulted only when the organisers were up against difficulties in setting up experiments etc., in the context of Ceylon's own environment. It was, generally speaking, a niggardly treatment all round of our University men, who have been all the time most keen and anxious to step into an area which most concerned them and their future students.

The " last scene of all that ends this strange eventful history" seems to be just round the corner.

A notice dated August 19, 1970, appeared in the Government Gazette and daily press informing the public that at the A.L. Examination in and after 1971, there will be two question papers in each of the subjects Physics, Chemistry, Botany and Zoology, the first paper consisting of approximately 100 test-items of fixed response multiple-choice type and the second paper of questions involving short-answer responses and structured essay-type questions. All practical tests would be abolished. Instead, the Director-General of Education would be taking steps to establish a pattern of continuous assessment of the practical work done by the students as part of their day-to-day study in the classes, i.e. in at least about 200 classes throughout the island. The practical work would be assessed systematically as directed by the Director-General and the Commissioner of Examinations. The eligibility for and entry to the Examination would be determined by this continuous assessment of practical work. Private candidates, on the other hand, would have to apply to the Commissioner, for the terms governing their eligibility.

The implications of this amount to there now being about 200 centres (= 200 AL schools), at least 200 examiners for practical work (= 200 biology teachers who will be doing the assessment) and the Examination (=continuous assessment) will be spread over

a couple of years. In other words there will be a " complexification " of the system with the resultant hazards, the greatest of all the hazards being the problem of bringing about uniformity in standards and adjudication, and the problem of disciplinary control over such a wide variety of both students and teachers, the students ultimately demanding that they be passed despite bad performances.

The press notification referred to was made by the Commissioner of Examinations on a ministerial directive to him to change the scheme of the Examination in these 4 science subjects and to implement it from 1971.

After the press notification appeared, a letter went out to the Professors of Physics, Chemistry, Botany and Zoology of all the four universities, announcing the ministerial directive and inviting them to a meeting to " discuss this directive ". The agenda for the meeting, however, listed only (a) The presentation of the Minister's directive (b) Discussion regarding implementation of the scheme and preparation of prototype question papers and (c) Revision of the syllabus for the 1972 examination.

In other words, a scheme was being foisted on the country without prior consultation with the universities and the universities were being asked more or less to conform or get out.

A Deputy Director-General of Education monopolised the discussion as far as the Government was concerned, and the mimeographed document he distributed before he began his monologue is a masterpiece of authoritarianism and bombast. No wonder the document bears the superscription " strictly confidential ". Since I may not quote from such a document, I can only give you an indirect glimpse of it by quoting a passage from Lionel Trilling's *The Liberal Imagination* :—

> " A specter haunts our culture. It is that people will eventually be unable to say 'they fell in love and married' let alone understand the language of *Romeo and Juliet*, but will as a matter of course say, 'their libidinal impulses being reciprocal, they activated their individual erotic drives and integrated them within the same frame of reference' ".

No wonder the communication gap between the teaching profession and the education bureaucracy is for ever widening, instead of closing.

The university professors, to a man, reacted strongly, to say the least, against this deplorable document as well as against the whole tone and manner in which they were being invited to fit into a predetermined plan. They were asked to consider ways of implementing the Examination design and not to review the design. The reviewing was to be done over the years, with feed-back from the total populations of Examination candidates or from 'suitable stratified random samples'.

This brings us to the subject of statistics. Colombo's Professor Emeritus of Physics, an alumnus of the Cavendish Laboratory at Cambridge, has already warned that " statistics is a tricky subject and ought to be handled only by experts in the subject and not by amateurs " (15). He wrote this in connection with the recent admissions to the universities on the 1969 AL Examination results.

An illustration of the danger of misinterpreting statistics is the fantastic suggestion made sometime ago that the lack of correlation in candidates' performance between Theory and Practical at examinations, pointed to something wrong in the examination system. When this very question was raised at the meeting, one of the professors pithily commented that if he wanted to recruit a person who could ride a bicycle, he would get that person to demonstrate his bicycle-riding ability by actually riding a bicycle, not by writing about a bicycle. Theory and Practical are different disciplines. If there were correlation between them a Theory paper alone would do for testing Practical ability.

All this concern with numbers, with statistics, is a laudable thing if done with competence rather than authoritarianism. It was a religious dignitary, of all people, who once remarked to me that only competence should be allowed to question and correct competence, not authority. Such mathematical tools as statistics and standardisation, used in educational practice, should not only be done by competent persons, but also be open to scrutiny by competent persons.

The recent admissions to the universities, again foisted by the authorities on bewildered and unwilling universities, are a case in point. The Government Department of Information has, however, issued a statement (16), clarifying the basis for the 1970 University admissions. Let us say at once that it is a very welcome statement, setting out the position fairly and squarely. The aims are most laudable. We ourselves have had considerable experience now with students from the rural areas. We have had the pleasure of seeing many of them flower in our institutions and have endeavoured at every turn to detect and remove any handicaps they encountered, especially those due to circumstances beyond their control. We have viewed with considerable alarm the great dearth of Sinhala Science Teachers and the poor standards and facilities obtaining in the rural schools. We acknowledge wholeheartedly that something had to be done and that the remedy, to begin with, lay in the hands of the most competent authority, namely the Ministry of Education. Let us see if there has been justice and equity. Here are the admission figures released by the Government Department of Information :—

		Number admitted	*Minimum Total Mark for Admission*
Engineering—Peradeniya	Sinhala	86	227
	Tamil	60	250
Engineering—Katubedde	Sinhala	60	212
	Tamil	53	232
Medicine—Peradeniya & Colombo	Sinhala	137	229
	Tamil	103	250
Dentistry—Peradeniya & Colombo	Sinhala	17	
	Tamil	24	
Agriculture—Peradeniya	Sinhala	25	
	Tamil	17	
Veterinary Science—Peradeniya	Sinhala	15	
	Tamil	5	
Biological Sciences—All 4 Universities	Sinhala	111	175
	Tamil	41	181
Physical Sciences—All 4 Universities	Sinhala	178	183
	Tamil	92	204
Architecture	Sinhala	16	180
	Tamil	28	194

(See also: Fig. 1 showing admissions to the Science Faculty, University of Ceylon, Peradeniya.)

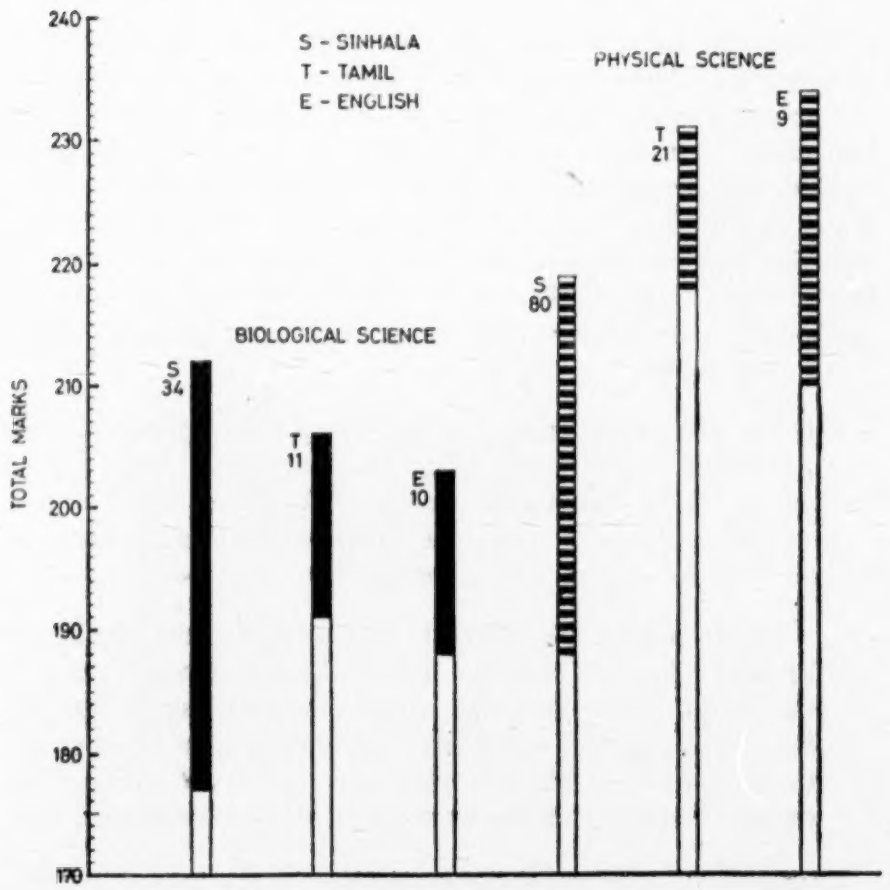

FIG. 1. Diagram showing admissions in 1970 to the Faculty of Science, University of Ceylon, on the basis of the total marks scored by candidates at the G.C.E. (Advanced Level) Examination of December 1969. The figures below the letters S, T and E indicate the numbers admitted in the respective language streams.

One thing appears to be certain about the selections made by the Ministry. The actual marks obtained by candidates remain the same and have not been tampered with. That is praiseworthy. But we find that the admission mark for one racial group is consistently lower than that for the other racial group. The question arises then as to why those many students of one racial group, who obtained marks between these two levels, have been rejected in favour of the other racial group. This is discrimination pure and simple.

It is a lack of justice and equity. It undermines all confidence in the authorities and even in the sense of worthwhileness in attempting to do well at an examination.

There also arises a subsidiary, but important, question. It is true that the marks have not been tampered with, which is all to the good. That being so, one would really like to know whether candidates from the rural schools have yet had a fair chance as against their counterparts in the so-called big schools. Nothing much of the kind seems to have happened. The rural schools have hardly been helped. All that has happened for certain is that one racial group has been discriminated against. Only a method of standardisation, on sound and accepted lines, could solve this problem.

It is also well to remember that we have got to be just and equitable, not simply to linguistic or racial groups as a whole, but to students as individual human beings. We should write in our institutions, in letters of gold, words similar to those of James A. Michener in his recent book *The Quality of Life:—*

> "I am not for Negro rights because I love the Negro but because I love all citizens. I love the grand possibilities of this nation and do not wish to see them diminish because we fail to utilize one of our greatest resources, the abilities of our twenty-five million black people.....We are cheating ourselves when we cheat any segment of our population" (17)

I would add, not only any segment, but also any single individual, of our population.

Some Trends in Scientific Research

You would think that what I have to say now has hardly any bearing on what I have already said. I mean to keep you guessing, however, to fire your imagination at least by the time I have done. I will be as brief as possible since the subject is rather embarrassing. In the course of my remarks I shall have to cite particular instances to illustrate my points. But unlike as in the previous sections I will not be able, for obvious reasons, to refer to names of authors and titles of documents. Rest assured, however, that the documents are in my safe keeping.

I want also to emphasize that I will firmly avoid any personal invective. Wherever possible I will use language in such a way as to obscure as completely as possible the identity of persons. Although it must be said that in our community, the community of scientists, we should welcome, rather than object to, lambastings for academic lapses. Despite J. B. S. Haldane's opinion that " in science, efficiency is more important than courtesy " (18), I shall try to be as courteous as possible.

We have been witnessing here in Ceylon, within the last 10 years at least, a rather deplorable academic rat-race, particularly among persons by all accounts well qualified in the sciences. This has been brought on mainly by the untimely multiplication of science faculties, without adequate scientific man-power to support them. There is no sign that this rat-race would not go on unabated. We probably need more universities, but we simply do not have the wherewithal to multiply science faculties at the rate we have been doing.

In any case, let us be warned about the type of academic man we are going to have at the helm of affairs in our places of scientific work. It is too well known that in university science departments one is particularly concerned about providing students with the basic equipment in knowledge, techniques and attitudes for the appreciation and practice of science in the country. If our teaching staffs, in their researches and other scientific endeavours, are themselves found wanting in the very things they are obliged to teach, the position is bleak indeed, because education is a hereditary process, " educational backwardness is self-perpetuating " (Jennings, 1944) (19).

I would now make concrete what I have hitherto only hinted at. I will give you only a few examples in order to illustrate the phenomenon, because my time is limited. It would make a very interesting study to estimate the number of significant and inexcusable lapses shown by so-called academics who are running in the race for position and status at the cost of the more important qualities of academic and scientific integrity, not to speak of excellence. This is not to say that we are altogether lacking in persons having

the latter qualities. The danger is they are too few and far between, to support adequately and influence the academic structure in a university.

Let us consider the following cases :—

(*a*) It was necessary in a certain set of experiments to maintain the pH at a definite level. This was done by the researcher, who had already had several years of post-graduate training abroad and a Ph.D., by merely adding HCl or NaOH to the unbuffered medium. He had no use for buffers to maintain pH for the rather prolonged periods of his experiments. To his credit, however, he had the honesty to describe in his manuscript his method of maintaining pH. We might well have called it " So-and-So's Method " if the manuscript had been finally published. Even a tenth grader in our schools would have known better.

(*b*) It was required to test the effect of a certain substance on an organism. The substance was used as a solution in alcohol and the organism apparently registered a sharp reaction to it. But one was at a loss to know how the organism would have behaved under the influence of the alcohol alone, without the other substance. The whole idea of a control experiment missed the mind of the investigator, who was a post-doctoral researcher.

(*c*) What would one think of an investigator, who in his or her hurry to record seasonal fluctuations of a particular organism or changes in species composition of a habitat, in relation to temperature changes, rushes into print, with the help of a willing publisher, with data collected for only one day and that too not for 24 hours. That person simply did not have the patience to do at least one replication, let alone a few replications, in this easily accessible spot. He or she probably feared that in that case the scientific world would have been kept waiting far too long to receive the brilliant findings. That investigator too was equipped with a Ph.D. degree.

(*d*) Ecological and physiological work and experiments often require even the most elementary statistical treatment.

It has been truly surprising to find raw numerical data lying untreated, and sometimes even uncommented on, although they were admirably suited in both quality and quantity to statistical treatment and comment. The high-point, however, in the use of statistics was reached when one young post-graduate researcher, supervised by a doyen in the field, calculated a standard deviation from only two readings available to him. A British colleague of mine who happened to see this in the manuscript he read, remarked, with characteristic understatement, " It is unrealistic to do so ".

I have given you only a glimpse, a sample, of the many cases I have come across of the lack, not of the imaginative leaps that go to make the first-class scientist, but of a true appreciation of the most elementary principles of scientific methodology and the ability to apply them and teach them, qualities fundamental to any researcher and teaching scientist, even if he or she does not belong to the charmed circle of the brilliant ones. Nor is this all. We have detected in recent times cases strongly suggestive of plagiarism, which have been of deep concern not only to responsible people in this country, but also to scientists abroad.

It is in this context that we have to examine the words of the Hon. Pieter Keuneman, Minister of Housing and Construction, in his address on the occasion of the opening of this 26th Session of our Association. " With all due respect " he said, " to the genuinely creative efforts at fundamental research, I think we must face the fact that, by and large, we have neither the need nor the financial or technical capacity to compete in this sphere. Such research work of a fundamental nature as we can afford to undertake should provide a take-off base for research projects of economic importance to our country and its people ". The problem is: could we provide even a take-off base under the conditions prevailing in our places of scientific training ?

We have to find quick remedies for this state of affairs. There has to be an insistence on rigorous standards in scientific research and publications. We have already begun to be much more exacting in refereeing for our journals of Science, and our panels of referees are also becoming more and more international. More

than all this, we must not waver from the path of criticism. We must cultivate, in our scientific and other academic circles, the art of giving as much as taking criticism, whenever academic standards are at stake. This is part and parcel of the scientific process whether it be in education or in research. " The pre-occupation of academic people " says Professor Michael Polanyi, " with assessing each others' merits may seem petty, but it is indispensable for the maintenance of scientific standards. For these standards cannot be explicitly specified, and can be upheld, therefore, only by the intuitive connoisseurship that traditionally permeates the scientific community. To this extent a university must be an ivory tower. And this is not due to snobbery or lack of social conscience; it simply represents the necessary condition for cultivating science effectively " (20).

Here I cannot help thinking that the traditional charm and politeness of us Ceylonese could often be a stumbling block to our scientific progress. For, in Science, as Haldane has remarked, efficiency is more important than courtesy.

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